Features

- Operating voltage 3.0-5.5V
- Built-in RC oscillator
- 8 SEG pins，4 GRID pins
- SEG pins connect to LED Anode , GRID pins connect to LED Cathode
- 7 × 4 key scan （Key display multiplexing requires hardware circuit cooperation）
- 2-wire serial interface
- 8-level brightness control
- Built-in 8×4 bit display RAM
- Power-On Reset(POR)

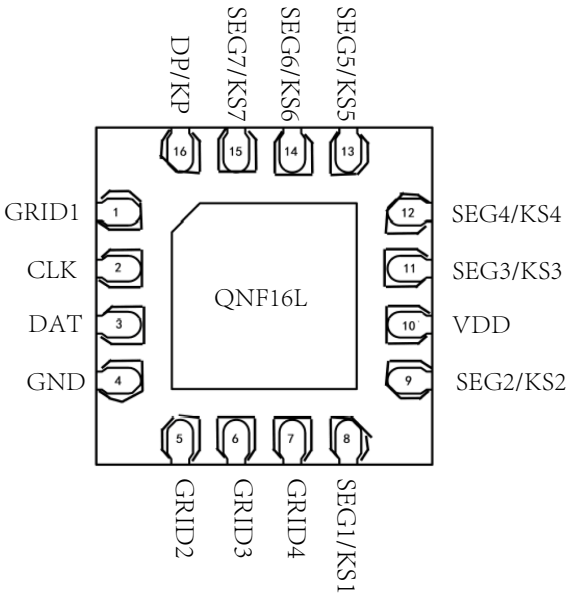
- Package:
  QFN16L(3.0mm x 3.0mm PP=0.5mm) .

1 General Description

VK1Q60 is a RAM Mapping LED display driver with key scanning circuit interface， LED display numbers in the device is 32 patterns (8SEG x 4COM) . SEG pins connect to LED Anode , GRID pins connect to LED Cathode. Support up to 7x4 keys. It is suitable for 24 hours long-term continuous work applications. QFN16L package.

2 Pinouts and pin description

2.1 VK1Q60 QFN16L Pin Assignment

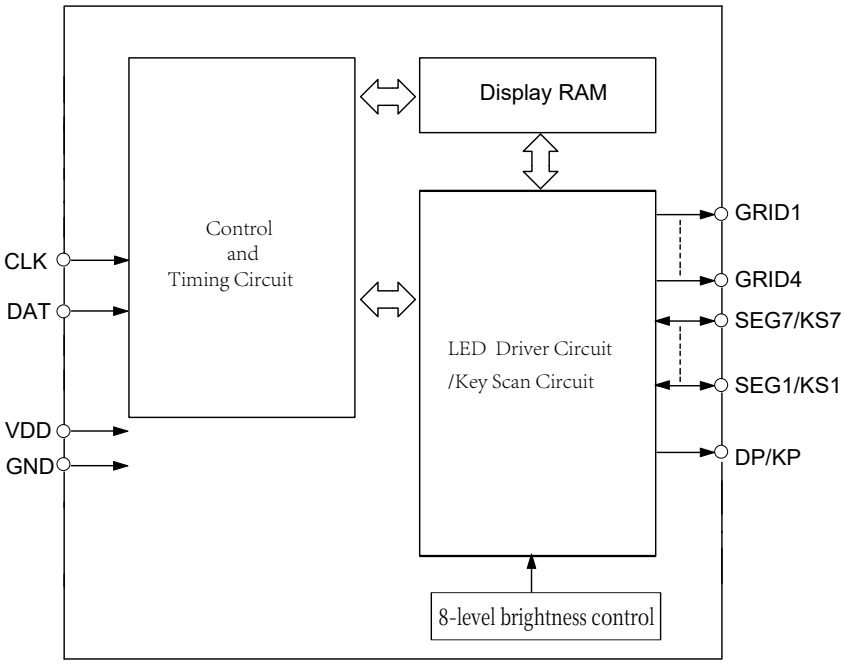


2.2 VK1Q60 QFN16L Pin Description

No.	Name	I/O	Function
1 5-7	GRID1-GRID4	O	LED GRID outputs（N-MOS open drain）;Key scan output.
2	CLK	I	Serial Clock Input，build-in pull-up resistor
3	DAT	I/O	Serial Data Input/Output
4	GND	GND	Negative power supply
8-9 9-15	SEG1/KS1- SEG7/KS7	I/O	LED SEG outputs；key scan input.
10	VDD	VDD	Positive power supply
16	DP/KP	O	LED GRID outputs；Also used as keyboard flag output

3 Functional Description

3.1 Block diagram



3.2 Display RAM

The static display memory (RAM) is organized into 8×4 bits and stores the displayed data. The contents of the RAM are directly mapped to the contents of the LCD driver. Display address is 0x68-0x6E, the RAM size is 4 bytes. If you want to lighted on or off an LED, only set or clear the corresponding display RAM bit to 1 or 0,For example, if LED1 driven by SEG1 pin and GRID1 pin is on or off, only set bit0 to 1 or 0 of the corresponding display RAM (0xc0).The ram bit corresponding to the unused SEG pin i s cleared to 0.

The following is a mapping from the RAM to the LED pattern:

SEG / GRID	DP	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	Address
GRID1								LED1	0x68
GRID2									0x6A
GRID3									0x6C
GRID4									0x6E
	D7	D6	D5	D4	D3	D2	D1	D0	

Note:

At the initial system power on, the value stored in the chip display RAM may be random. It is recommended to clear the display RAM after power on, write 0x00 to the all display RAM (0x68-0x6E).

SEG pins connect to LED Anode, GRID pins connect to LED Cathode, Reverse connection is not allowed.

3.3 Keyscan

The keyboard scan code corresponding to VK1Q60 is shown in the following table:

	GRID4	GRID3	GRID2	GRID1
SEG1/KS1	47H	46H	45H	44H
SEG2/KS2	4FH	4EH	4DH	4CH
SEG3/KS3	57H	56H	55H	54H
SEG4/KS4	5FH	5EH	5DH	5CH
SEG5/KS5	67H	66H	65H	64H
SEG6/KS6	6FH	6EH	6DH	6CH
SEG7/KS7	77H	76H	75H	74H

Note:

When using the button function, must connect a 2KΩ resistor in series with the GRID pin. Combination keys are not supported.

3.4 Serial Communication Command

3.4.1 Communication Interfacing

2 lines are required to interface with the VK1Q60.

The CLK line is the clock input pin, the data on the DAT line are Transmitted into the VK1Q60 on the rising edge of the CLK signal.

The DAT pin is the serial data input pin， Data input and output of serial interface.

The starting condition is that when CLK high,DAT changes from high to low; The end condition is that when CLK is high, DAT changes from low to high.

ACK： If the communication is normal, VK1Q60 will pull DAT low on the 8th falling edge of the serial communication clock. Until the 9th clock rising edge is detected, DAT is released as an input state.

3.4.2 Command Description

The command is a 2-byte command, the high byte is the command,the low byte is the set parameter, the written display data or the returned key value.

There are 3 types of high byte commands:

I. System Set Cmd --- Configuration parameter
II. Write the Display Data Cmd --- Write the Display Data
III. Read key Cmd --- read the key value

high byte cmd　　low byte parameter or data

Start	C7	C6	C5	C4	C3	C2	C1	C0	Ack	D7	D6	D5	D4	D3	D2	D1	D0	Ack	Stop

3.4.2.1 System Setting Command

This command is used to switch the display, set the display mode, display brightness and sleep.

		MSB							LSB		
Func	Byte	B7	B6	B5	B4	B3	B2	B1	B0	Note	
CMD	1st	0	1	0	0	1	0	0	0	System Setting Command	
parameter	2nd	Fill in 0	0	0	0		0	Fill in 0		brightness setting	8 levels of brightness
			0	0	1		0				1 levels of brightness
			0	1	0		0				2 levels of brightness
			0	1	1		0				3 levels of brightness
			1	0	0		0				4 levels of brightness
			1	0	1		0				5 levels of brightness
			1	1	0		0				6 levels of brightness
			1	1	1		0				7 levels of brightness
						0	0			7/8 SEG display mode	8 SEG display
						1	0				7 SEG display
			0	0	0	0	0		0	Display on/off	display off
							0		1		display off
			0	0	0	0	1		0		standby mode

3.4.2.2 Write Display Data Cmd

Write display data commands 0x68-0x6E to write data to GRID1 -GRID4,each 1bit of display data corresponds to 1 SEG.

		MSB							LSB	
function	byte	D7	D6	D5	D4	D3	D2	D1	D0	Note
write display data cmd	1st	0	1	1	0	1	0	0	0	0x68 write display data to GRID1
		0	1	1	0	1	0	1	0	0x6A write display data to GRID2
		0	1	1	0	1	1	0	0	0x6C write display data toGRID3
		0	1	1	0	1	1	1	0	0x6E write display data to GRID4
display data	2nd	X	X	X	X	X	X	X	X	display data bit7-DP,bit6-SEG7,...bit0-SEG1

3.4.2.3 Read Key Cmd

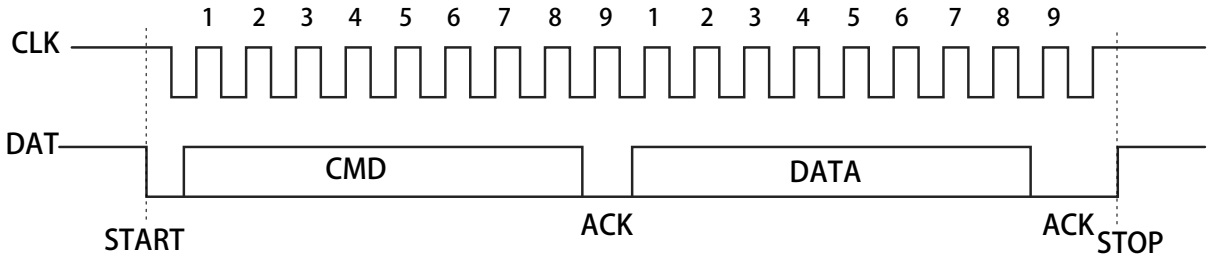
This command is used to read the value of a key. The key only supports a single key, and does not support multiple keys to be pressed at the same time.

		MSB							LSB	
function	byte	B7	B6	B5	B4	B3	B2	B1	B0	Note
Cmd	1st	0	1	0	0	1	1	1	1	Read Key Cmd
key value	2nd	x	x	x	x	x	x	x	x	Value of Key scan

4. Command Timing

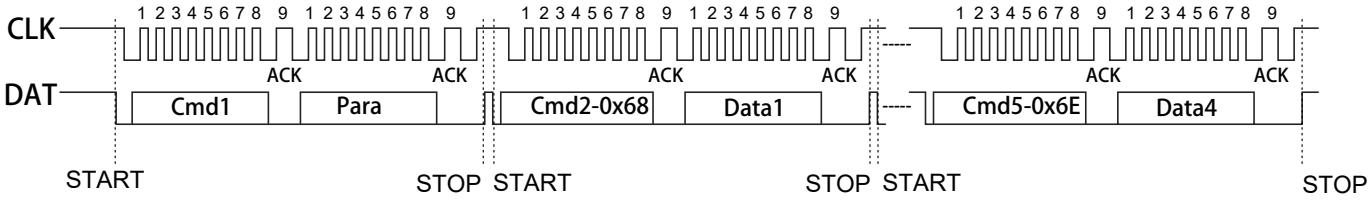
4.1 Write display data timing

Write the display number command (0x68-0x6E) first, and then send 1 byte of display data after the command is sent.



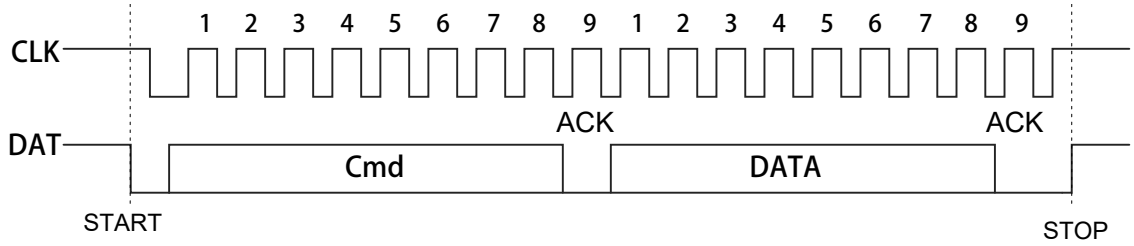
CMD： Write display data Cmd->0x68-GRID1,0x6A-GRID2,0x6C-GRID3,0x6E-GRID4
DATA: Write display data->bit7-DP,bit6-SEG7,...bit0-SEG1

4.2 System Settings & Write display data timing



Cmd1： System Set Cmd
Para ： Display parameters->display on， set the number of LED display segment， Set display brightness level
Cmd2： Write display data Cmd 0x68.
Data1： Send the display data to GRID1.
.....
Cmd5： Write display data Cmd 0x6E
Data4： Send the display data to GRID4.

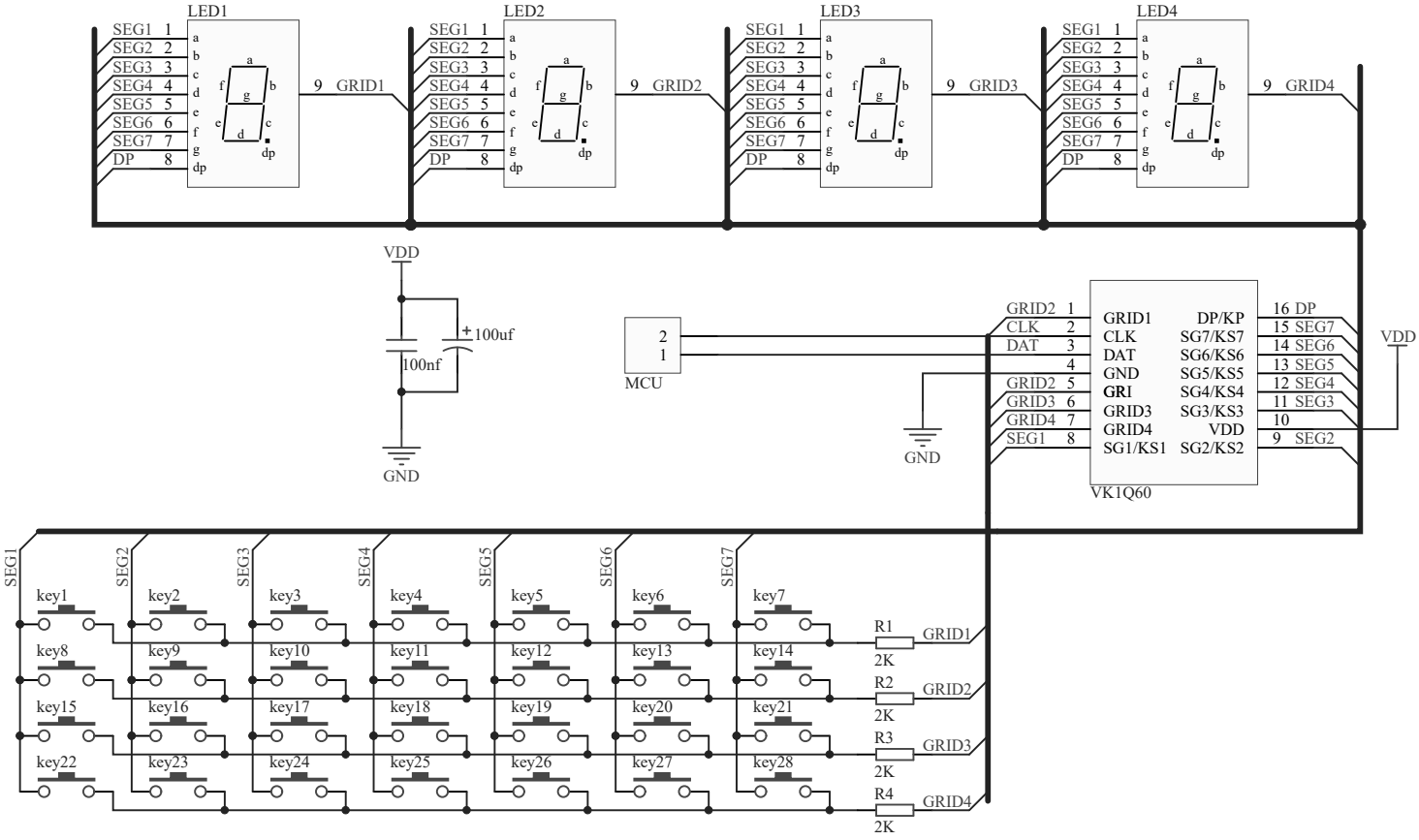
4.3 Read Key Timing



Cmd: Send Read Key Scan Cmd (0x4F).
DATA: Key Scan Data Read.

5 Application Circuits

8-SEG LED Display shared Cathode



6 Electrical characteristics

6.1 Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Power voltage	VDD	-0.5～6.5	V
Input Voltage	VIN	V_{SS}-0.5～V_{DD}+0.5	V
Storage Temperature	T_{STG}	-55～+125	℃
Operating Temperature	T_{OTG}	-40～+85	℃

6.2 DC Characteristics

Test Conditions：Ta=25℃，VDD =5V

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Operating Voltage	VDD	3	5	5.5	V	—
Power current	I_{DD}	—	80	150	mA	—
Static Current	ICs	—	0.3	0.6	mA	CLK、DAT、KP High level
Sleep current	ICslp	—	0.05	0.1	mA	CLK、DAT、KP High level
High Level output Current	I_{OHSEG}	—	-25	—	mA	VO=VDD-2V SEG1-SEG7,DP
Low Level output Current	I_{OLGRID}	—	150	—	mA	VO=0.3V GRID1-GRID4
Input Low Voltage	VIL	-0.5	—	0.8	V	CLK、DAT
Input High Voltage	VIH	2.0	—	VDD+0.5	V	CLK、DAT
Input Low Voltage1	VIL_{ki}	-0.5	—	0.5	V	KS
Input High Voltage1	VIH_{ki}	1.8	—	VDD+0.5	V	KS
output Low Voltage1	VOL_{dig}	—	—	1.2	V	GR pin current-200mA
output Low Voltage2	VOL_{dig}	—	—	0.8	V	GR pin current-100mA
output High Voltage2	VOH_{dig}	4.5	—	—	V	GR pin current-5mA
output Low Voltage3	VOL_{ki}	—	—	0.5	V	KS pin current-20mA
output High Voltage3	VOH_{ki}	4.5	—	—	V	KS pin current-20mA
Input pull-down current	I_{DN1}	-30	-50	-90	uA	KS
Input pull-up current	I_{UP1}	100	200	300	uA	CLK
Input pull-up current	I_{UP2}	150	300	400	uA	DAT
Output pull-up current	I_{UP3}	500	2000	5000	uA	KP
POR Voltage	V_R	2.3	2.6	2.9	V	POR

6.3 AC Characteristics

Internal timing parameters (Test Conditions: Ta=25℃, VDD=5V)

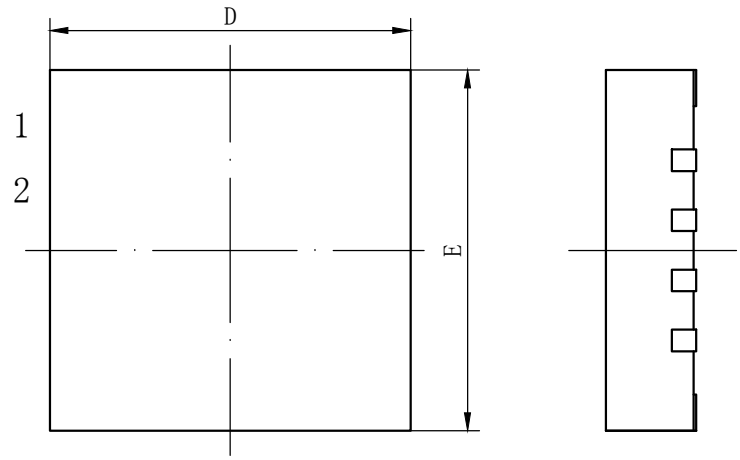
Item	Symbol	Min.	Typ.	Max.	Unit
Power-on reset time	T_{PR}	10	25	60	ms
Display scan period	T_P	4	8	20	ms
key response time	T_{KS}	20	40	80	ms

Serial communication parameters (Test Conditions: Ta=25℃, VDD=5V)

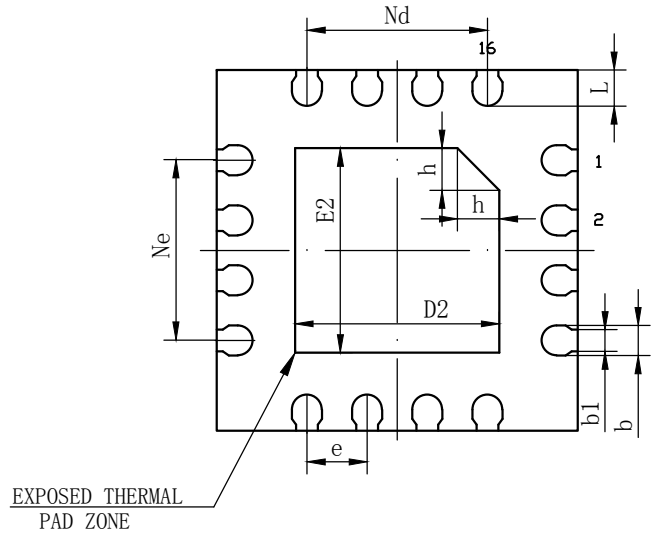
Item	Symbol	Min.	Typ.	Max.	Unit
DAT falling edge start signal setup time	T_{SSTA}	100			ns
DAT falling edge start signal hold time	T_{HSTA}	100			nS
DAT rising edge stop signal setup time	T_{SSTO}	100			ns
DAT rising edge stop signal hold time	T_{HSTO}	100			ns
CLK clock signal low-level width	T_{CLOW}	100			nS
CLK clock signal high-level width	T_{CHIG}	100			nS
DAT input data to CLK rising edge setup time	T_{SDA}	30			nS
DAT input data to CLK rising edge hold time	T_{HDA}	10			nS
Delay of DAT output data valid to CLK falling edge	T_{AA}	2		30	nS
Delay of DAT output data invalid to CLK falling edge	T_{DH}	2		40	nS
Average data transfer rate	R_{ate}	0		4M	bps

7 Package Information

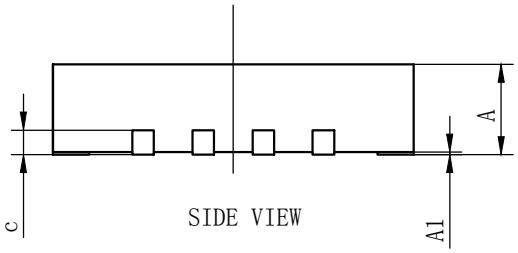
7.1 QFN16L(3.0mm x 3.0mm PP=0.5mm):



TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.18	0.25	0.30
b1	0.18REF		
c	0.203REF		
D	2.90	3.00	3.10
D2	1.60	1.70	1.80
e	0.50BSC		
Ne	1.50BSC		
Nd	1.50BSC		
E	2.90	3.00	3.10
E2	1.60	1.70	1.80
L	0.25	0.30	0.35
h	0.30	0.35	0.40

8 Revision history

No.	Version	Date	Modify the content	Check
1	1.0	2018-08-10	Original version	Yes
2	1.1	2019-07-11	Add Ref circuits	Yes
3	1.2	2020-02-11	Update content	Yes

Disclaimers

Information in this document is believed to be accurate and reliable. However, VinKa does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information. VinKa reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof. For the latest information, please visit https://www.szvinka.com Or contact VinKa's staff.